

THURSDAY, JULY 1, 1875

SIR WILLIAM EDMOND LOGAN

BY the death of this illustrious geologist and most genial man, science has been deprived of one of her bravest and best soldiers, while those who personally knew him have lost a true, warm-hearted friend.

One by one the magnates by whose toil geology rose during the first half of this century are taken from us. Link after link is broken in the chain of living men who have served to bind us personally with the birth and infancy of that science. Few were left to us, and of these few none more honoured and beloved than the veteran who has just been called away. Of Scottish parentage (his father having been a landed gentleman in Stirlingshire, who had emigrated to Canada), W. E. Logan was born at Montreal in the year 1798. He was sent home to the old country for his education, and studied, it is believed, both at the High School and the University of Edinburgh. Eventually, having developed an ardent love for geological pursuits, he settled in South Wales and began to study the structure of the great coal-field of that region. It was there that he fostered that habit of patient and exact observation, combined with quickness of eye in seizing the salient points in the geological structure of a region, which stood him in such good stead in later life. During a series of years he carefully followed the outcrops of the various coal-seams, tracing the positions of the numerous faults by which they are traversed, and putting all his data upon the one-inch sheet of the Ordnance Survey. These maps of the South Welsh coal-field were probably the first in this country, on so large a scale and of so extensive a district, where the details of geological structure were depicted with such minuteness. They were generously handed over to Sir Henry de la Beche when he began the Geological Survey in that region, and he found them so admirable that he adopted them for the Government Survey, on the early sheets of which the name of W. E. Logan is engraved in conjunction with those of De la Beche, Ramsay, Phillips, and Aveline. He worked on the staff of the Survey as an enthusiastic volunteer, lending invaluable assistance in the South Welsh region, and among other services introducing horizontal sections on a true scale of six inches to a mile, which served as models for the large sections of the Survey.

One of the most important observations made by Logan during this early part of his career was one relating to the origin of coal. He pointed out, what is now so universally recognised and yet does not seem ever to have struck anybody before, that each coal-seam rests upon an under-clay or fireclay in which rootlets of *Stigmæria* branch freely in all directions. This association of coal and *Stigmæria*-clay he found to be so general that it could not be regarded as accidental. He suggested that the clay represented an ancient soil or mud in which the *Stigmæria* grew, and that the coal stood now in place of the matted vegetation which grew upon that soil. The value of this contribution to our knowledge of the history of coal and of the changes in physical geography to which the stratified rocks bear witness, can hardly be over-estimated.

In the summer of 1841 Mr. Logan went to America and

spent the autumn of that year in explorations of the coal-fields there. He examined the Pennsylvanian region, which had been studied by Rogers, and afterwards went through the coal-districts of Nova Scotia, where he made some original observations. He spent the winter of 1841-1842 in Canada, devoting himself among other things to watching the behaviour of ice as a great geological agent on the rivers. In the spring of 1842 he took his place again at the Geological Society of London, and gave there some interesting details regarding what he had seen during his absence on the other side of the Atlantic.

About this time (1842) there arose in Canada a desire to know something more about the mineral resources of the colony, and the Legislature went so far as to vote a sum of 1,500*l.* for a geological survey. The Canadian authorities consulted the Home Government as to a suitable person to take charge of the undertaking, mentioning at the same time Mr. Logan's name, and requesting information as to the estimation in which his scientific qualifications were held in this country. Murchison happened at the time to be President of the Geological Society. The official request being forwarded to him, he recommended the proposed appointment in the warmest terms, as one that would "render essential service to Canada, and materially favour the advancement of geological inquiry." This testimony and doubtless the warm support of his old friend, De la Beche, led to Mr. Logan's appointment as organiser and director of the survey of the rocks and minerals of his native country.

From the commencement of this work in 1843 Mr. Logan's whole energies were given to the task which had been assigned to him, and never did a public servant toil more earnestly and disinterestedly for the attainment of the great purpose of his office. He had to struggle on, with little encouragement, in the face of difficulties which only a brave and devoted nature could have faced. First of all, his official position was for many years a most precarious one. Though the Legislature, in a fit of patriotic fervour, had sanctioned the equipment of a geological survey, and had voted a slender sum for its maintenance, yet it soon naturally enough began to ask what value it received for the money thus expended. The Ministers of the day could not always satisfy utilitarian legislators, and indeed Ministers themselves were not infrequently lukewarm friends if not avowed enemies to the young Survey. Mr. Logan's tact in steering his bark through all these obstacles, and finally gaining the haven of popularity both for it and for himself, is above all praise. Yet this was done without the surrender of any of the thoroughly scientific spirit in which his labours were at first conceived. He and his associates worked steadily as true men of science, but they never forgot that in a young country, with resources not only undeveloped but unknown, the exploration of its mineral wealth was a matter of primary importance. Hence year by year, in the reports of progress presented to the Canadian Parliament, he was able to give fresh information regarding commercially important rocks and minerals, while at the same time putting forward facts of the highest interest to students of geology all over the world. It is in these official reports that the chief work of Sir William Logan's life is embodied, including of course the admirable maps on which the field-work has been published.

But his difficulties lay not only in official quarters. He had to go forth into the forest and ascend unvisited rivers without a track or a map. He had to make his own map as he went along, camping out with Indian attendants for months together, and forcing his way as a true pioneer of civilisation, through solitudes which in a few years later were to become scenes of active industry. Through all such hardships he carried a devotion which not only brought him cheerily to the end of them, but inspired his officers with much of his own energy in the common cause. And not his own small staff merely, but farmers, country doctors, and settlers of all kinds whom he enlisted into his service for such work as he found them able and willing to undertake. He used, for instance, to describe graphically and with much quiet humour how in this way he got a number of utterly unscientific colonists to aid in tracing a band of limestone through a district where no rock could be seen for the covering of soil and drift. He provided them each with a long iron-pointed stick and an acid-bottle, and instructed them to thrust the stick well down through the soil till they struck it against the solid rock underneath. Thereupon, pulling it out, they were to apply a drop of acid to the bruised grains of stone adhering to the point of the stick. If they saw a brisk effervescence, they were to mark the place as lying on limestone.

The organisation of the Canadian Geological Survey was admirably adapted for the work to be done, and shows Sir William's skill as an administrator. Directing the whole operations himself, working personally in the field at original observation as well as visiting and superintending the field-work of his staff, he had to get the utmost amount of work done for the smallest amount of money. He secured some excellent assistants in the field-work, whose names have long been familiar to geologists—Alexander Murray, now ably directing the Newfoundland Survey, James Richardson, and, in later years, Robert Bell and others. He early saw that the field-work required to be aided in two important directions—mineralogical and chemical analysis, and palæontological determination. Accordingly, he obtained for the former subject the services of Dr. Sterry Hunt, whose reports on Canadian rocks and minerals and contributions to chemical geology have since become so well known; while for the latter he fortunately found and retained Mr. Billings, who has done such good work among the invertebrate fauna of the older palæozoic rocks of British North America. Ever ready himself to give information and assistance, he everywhere solicited and obtained it from others for the advancement of the Survey.

Of the benefits which the Survey has conferred on Canada, perhaps the best proof is furnished by the firm footing and comparatively liberal equipment which it has now obtained from the Provincial Legislature. The Survey has opened up in a systematic and trustworthy way the mineral structure and resources of the colony. It has formed a museum and laboratory in which the minerals, rocks, and fossils of the country are examined and illustrated with special reference to the industrial development of the country. It has been the means of creating reliable topographical maps over wide regions which had not previously been depicted on any map.

It would take longer to enumerate the many services

which Sir William Logan's Survey has rendered to Geology. Foremost among them we should probably place the great additions which it has made to our knowledge of the stratigraphy of the older formations. The existence of the vast Laurentian system with its twofold set of rocks and its Eozoon limestone was a fact first made known by Logan and his associates. The position of the Huronian system was likewise recognised and its name given by them. The northward development of the well-subdivided North American Silurian series with its abundant and characteristic fauna has been most diligently followed out and described by the same band of observers. They have, moreover, given the Survey a European reputation for their chemical and mineralogical work, and for their contributions to our knowledge of some of the older forms of palæozoic life.

These various and admirable labours were in large measure inspired by the genial enthusiasm of the director. The official narrative of them contains the record of the main work of his life. During more than a quarter of a century, while constantly engaged in active and successful exploration, he hardly ever published any papers except in the parliamentary blue-book, in which his annual report was ordered to appear. He seldom came before scientific societies with an account of his discoveries, but cheerfully accepted the more restricted circulation and flimsy appearance of the Yearly Report to the Government. The generalised summary which he published in 1863, in a thick volume, on the progress of the Survey during the first twenty years of its existence, contains the gist of his work, as well as a luminous account of all that was then known of the geology and mineral wealth of the province.

In the year 1856, after his successful representation of the mineral productions of Canada at the Paris Exhibition of 1855, Sir William Logan received the honour of knighthood in recognition of his long and unwearied exertions in the task which he had undertaken. He met with abundant tokens of appreciation from scientific societies both in Europe and in America, and he had the great gratification of seeing that this widespread testimony to the value of his labours and those of his associates was [not without its influence upon society in Canada. By impressing his fellow-countrymen with the idea that after all there might be something useful and even to be proud of in their Geological Survey, it probably in no small measure helped to secure the position of the Survey as an institution deserving of support and extension.

In the year 1869 Sir William, finding at last that the duties of his office were becoming too heavy for his advancing years and failing health, resigned his appointment, and was succeeded by Mr. A. R. C. Selwyn, who had served in the Geological Survey of Great Britain, and afterwards directed the Survey of Victoria. His unabated interest in his favourite science, however, was shown by his donation of \$20,000 towards the endowment of the Chair of Geology in McGill College, Montreal.

Sir William's collected papers and reports would make several stout volumes. They were always written clearly and for the sole purpose of telling what he had seen and believed or inferred. They did not in the least address themselves to the general or popular audience. Indeed, he used to confess himself wholly at sea when called upon

to address such an audience, either with the pen or the voice, and gave as an illustration a great meeting convened by his fellow-citizens to welcome him back to Canada after he had been knighted. He was, of course, expected to say something of himself and of his visit to Europe. He tried his best, he said, but soon grasping a long pointer, turned round to some maps and diagrams illustrative of the geology of Canada, and only recovered his peace of mind and command of language when he found himself once more among Laurentian, Huronian, gneiss, limestone, and the rest of his beloved rocks. Nevertheless, he kept copious journals of his various expeditions, and illustrated them with most admirable pen-and-ink sketches. A selection from these could hardly fail to be of great interest, both in relation to the man himself and to the way in which geology has to be carried on amid the wild life of the backwoods.

By those who were privileged with his friendship, Sir William Logan will be affectionately remembered as a frank, earnest, simple-hearted man, ever gentle and helpful, enthusiastically devoted to his profession, and never happier than when discussing geological questions in a *tête-à-tête*, full of quiet humour, too, and showing by many a playful sally in the midst of his more serious talk, the geniality and brightness of his sunny nature. Peace to his memory! He has done a great work in his time, and has left a name and an example to be cherished among the honoured possessions of geology.

ARCH. GEIKIE

TREVANDRUM MAGNETIC OBSERVATIONS

Observations of Magnetic Declination made at Trevandrum and Agustia Malley in the Observatories of his Highness the Maharajah of Travancore, G.C.S.I., in the Years 1852 to 1869. Vol. i. Discussed and edited by John Allan Broun, F.R.S., late Director of the Observatories. (London: Henry S. King and Co.)

WE have heard a great deal lately about the native rulers of India, and the worst features of one of them have been brought very prominently before us; but it is a pleasing reflection that they are not all like the potentate of Baroda, while some of them might even read a lesson to the paramount power. Let us hear what Mr. J. Allan Broun, a magnetician of great eminence, has to say of the late ruler of Travancore.

"The Trevandrum Observatory," he tells us, "owed its origin in 1836 to the enlightened views of his Highness Rama Vurmah, the reigning Rajah of Travancore, and to the encouragement given to them by the late General Stuart Fraser, then representing the British Government at Trevandrum. His Highness, desirous that his country should partake with European nations in scientific investigations, sanctioned the construction of an observatory, named Mr. Caldecott its director, and gave him power to furnish it with the best instruments to be obtained in Europe."

The peculiar position of Trevandrum, not far from the magnetic equator, induced Mr. Caldecott, with the Rajah's permission, to procure from Europe a complete equipment of the best instruments for magnetic and meteorological observations, and to build a magnetic observatory, which was completed in 1841.

Mr. Caldecott died at Trevandrum in 1849, and the

observatory was in January 1852 placed under the direction of Mr. John Allan Broun, who had previously directed with well-known success the observatory of Sir T. Brisbane at Makerstoun, in Scotland.

Mr. Broun began his office with the conception of an interesting and important problem in terrestrial magnetism, which he was determined as far as possible to work out. This would render it necessary that the observations should not be limited to a single station. He wished, among other things, to determine how far the physical constants of terrestrial magnetism and their various changes depend on differences of height, of latitude, and of longitude.

The Agustia Malley, the highest mountain in the neighbourhood, was chosen as affording the best means for determining the effect of height, and accordingly Mr. Broun resolved to erect an affiliated observatory on this nearly inaccessible rocky peak, surrounded by forests, the inhabitants of which were elephants and tigers. These and all other difficulties connected with this formidable undertaking were, however, completely vanquished, and the Agustia Observatory was completed in 1855.

We learn from Mr. Broun that his labours were not entirely confined to these two observatories. "Other observations," he tells us, especially of magnetic declination, were made simultaneously "during short periods at different stations in Travancore, as nearly as possible on the magnetic equator, 90 miles north of Trevandrum, and also 40 miles to the south. Observations connected with meteorological questions were also made simultaneously to the east and west, and about 5,000 feet below the Agustia peak, on the peak itself, and at Trevandrum; while on one occasion hourly observations were made during a month at five different stations, varying gradually in height from the Trevandrum Observatory (200 feet) to 6,200 feet above the sea-level, in which fifteen observers were employed."

In this first volume Mr. Broun has confined himself to the magnetic declination, and one of the chief objects sought has been to determine every possible action of the sun and moon upon the magnetic needle. The observations extend from 1852 to 1870, and embrace in all nearly *three hundred and forty thousand readings*.

A considerable portion of the introduction is devoted to the discussion of a question which has, we think, been somewhat too much overlooked. When a magnet is suspended by a thread and enclosed in an appropriate box, it does not necessarily follow that all its movements are due to magnetic causes, for changes in temperature and humidity may affect the zero of torsion of the thread, and thus cause slight changes in the position of the suspended magnet. It is perhaps unlikely that such changes could seriously affect the character of the daily variation, but it has been thought that they might perceptibly affect the annual variation, since in this case the magnetic change is comparatively small, while the range of temperature and humidity is generally great.

Mr. Broun overcame this source of error by observations of an unmagnetic brass bar suspended in the same way as the magnet, which thus afforded him the means of estimating, and hence eliminating, the error due to these causes.

Besides all this, several declinometers were used and